



# jsc

National Aeronautics and  
Space Administration



R O U N D U P

SPRING 2016



Time flies  
when you're  
inflight



# The director of JSC

## Ellen Ochoa



PHOTO: NASA

**IT'S NOT BUSINESS AS USUAL AT JOHNSON SPACE CENTER.** We are accomplishing spectacular milestones through a combination of expertise, hard work and new, improved processes and collaborations. From Exploration Flight Test-1 more than a year ago to the recent safe and successful completion of the one-year mission, we are collecting vital information and moving a step at a time closer to Mars. We are also reaching out and informing a much larger audience than ever before thanks to social media and a concerted effort—both at JSC and across the agency—to tell our story in a way that connects the dots.

A few years ago, as I addressed audiences or simply talked informally with people around the country, I got asked about the end of shuttle and whether we were shutting down JSC. Today, I'm constantly asked about what we're learning from the International Space Station (ISS), when the next Orion mission is and what it will take to go to Mars. The conversation has changed.

One measure of this is the interest in popular culture. Movies such as "The Martian" and videos like One Direction's "Drag Me Down," shot entirely at JSC, have garnered a huge amount of interest. Closer to home, the more than 18,000 people who recently applied to become an astronaut is well over twice the previous record of 8,000 in 1978.

At JSC, we must keep pace with changes in the spaceflight environment to remain relevant. JSC 2.0, along with related efforts, have resulted in streamlined processes and improved results. The Class 1-E processes for experimental flight hardware led to the

2X2015 projects and this year's X projects, all providing the ability to get test hardware into space for better utilization of the space station as an exploration test bed. The Revolutionize ISS for Science and Exploration (RISE) effort changes the paradigm of the program's processes to consider the customers' points of view. The Procurement and Chief Financial Officer offices collaborate much more closely than before to improve their service to all the organizations at the center. Many more examples show that people across JSC are engaged in innovation to accomplish our mission.

In the 2015 Employee Viewpoint Survey, your responses led to JSC being ranked #1 out of 318 federal agency subcomponents (i.e., centers of federal agencies across the country, including all NASA centers) in the area of innovation based on scores from these three questions:

- I feel encouraged to come up with new and better ways of doing things.
- I am constantly looking for ways to do my job better.
- Creativity and innovation are rewarded.

That is an awesome result! Thank you for applying your ingenuity and energy to advance human exploration.

*Ellen Ochoa*



On Jan. 16, Expedition 46 Commander Scott Kelly shared photographs of a blooming zinnia flower in the Veggie plant growth system aboard the International Space Station. Kelly wrote, "Yes, there are other life forms in space! #SpaceFlower #YearInSpace"

PHOTO: NASA



The crew module pressure vessel for Exploration Mission-1 was loaded into a structural tool at Kennedy Space Center in Florida.

PHOTO: NASA



Engineers at Langley Research Center in Virginia load two test dummies into a mock-up of Orion in February.

PHOTO: NASA



Engineers examine one of Orion's solar array wings after it was successfully deployed in a Feb. 29 test at NASA Glenn's Plum Brook Station in Ohio.

## A spring in Orion's step

### **SPRING IS BRINGING A BEVY OF ACTIVITY FOR ORION, NASA'S NEXT-GENERATION SPACECRAFT THAT WILL SEND ASTRONAUTS ON THE JOURNEY TO MARS.**

At NASA centers across the country, engineers continue to assemble the Orion spacecraft that will fly atop the Space Launch System rocket in 2018 while also making progress getting ready for missions with crew in the coming years.

At Langley Research Center in Hampton, Virginia, testing has begun to assess the crew module structure and evaluate crew safety for splashdown. Teams have outfitted a representative Orion capsule with the heat shield that flew in space in 2014 and test dummies to help examine how the dynamics and loads Orion will experience when it hurtles back to Earth from lunar velocities will affect the crew. A series of tests are taking place in which the test capsule is dropped into a basin of water from different angles, and the test dummies will wear actual spacesuits in several of the evaluations.

The Orion for Exploration Mission-1 arrived to Kennedy Space Center in Florida in early February, and there, a team of NASA and Lockheed Martin personnel have been getting it ready to be outfitted with more than 100,000 components that will arrive at Cape Canaveral in the next 18 months. Meanwhile, at NASA Glenn's Plum Brook Station facility in Sandusky, Ohio, engineers have performed a deployment test of one of the solar array wings attached to the spacecraft's service module, as well as a series of assessments where Orion will be shaken and rattled to make sure it can withstand its harsh launch environment.



## With connectivity... comes meaningful connection

**IN MID-FEBRUARY JENNY GRUBER, LEAD OF THE INVENTORY AND STOWAGE OFFICER GROUP AT JOHNSON SPACE CENTER,** conducted a Speakers Bureau outreach activity in the Mission Control Center (MCC) viewing room—the students clamoring to hear more about the possibilities of spacesuited boots on Mars and science, technology, engineering and math (STEM) careers. But this was no cookie-cutter event. It was conducted in the dead of night—on an iPad—and Gruber was presenting to students from One Planet International School in Addis Ababa, Ethiopia.

Jenny Gruber demonstrates how she conducted a Skype outreach session in the MCC viewing room.



NASA/BILL STAFFORD

The Skype outreach session was imagined back in December, when Gruber was back in Africa after her previous few trips—each about three years apart.

“My son was born in Ethiopia, and he was adopted into our family when he was 10 months old,” Gruber said. “So we celebrate that heritage as a family, and we are personally invested in Ethiopia.”

For the space-loving Gruber, the opportunity to share NASA's message never rests. Even while on a family vacation, she connected with STEM outreach folks at the new Entoto Observatory and went to tour the flagship facility.

Students and teachers from One Planet International School were doing the same thing.

“We just happened to show up around the same time,” Gruber said of the fortuitous meeting. “And they said, ‘Oh, you guys are from NASA—can we talk to you?’ And I said, ‘Yeah, I’ve Skyped with Girl Scouts before, so let’s just do that.’”

A little over a month later and Gruber was in the MCC viewing room, wielding her iPad to teleport the kids into the nucleus of human spaceflight.

“They connected their computer to a big screen so the kids could see what was going on, and I just took them on a little virtual tour of the control center,” Gruber said.

After explaining some of the mechanics of operating a space program from the ground, Gruber opened it up for questions.

“Ethiopia is doing some very exciting things in space—the observatory being the newest thing—and they’re also working on a weather satellite that will go up in a few years, which is key for east Africa,” Gruber said. “After the weather satellite, they’re looking at interplanetary probes. They would also like to have their own human space program, but certainly, an Ethiopian astronaut at some point. I made sure to point out to the kids we’re counting on them in the next couple of decades to be the ones to get that done.”

Gruber also made sure to tell the students that they had their own special heritage to fulfill on behalf of humankind.

“[Ethiopia is] where the first human bones—Lucy—were found,” Gruber said. “It’s where people first came from, so it’s really neat to think about them continuing with that exploration. Someone asked me, ‘What’s the point of us going to Mars, or colonizing anything in the solar system?’ And I said, ‘Well, that’s just what humanity does, right? Humanity started in Ethiopia and branched out, so it would make sense that we would then go from Earth.’ It was a really great conversation.”

The conversation did not only benefit the kids, though they were happily swept up in the inspiration and intrigue involved with exploring beyond Earthly bonds.

“I’ve been able to have some pretty amazing life experiences because I was inspired by human space exploration, so I feel an obligation to continue that legacy,” Gruber said.

Have you caught the outreach bug yourself? Do you want to share NASA's message with students and the community? Visit the following website for more information on how you can give back: <https://nasajsc.secure.force.com/vcorps>



## Compact, all-in-one exercise device flies to station

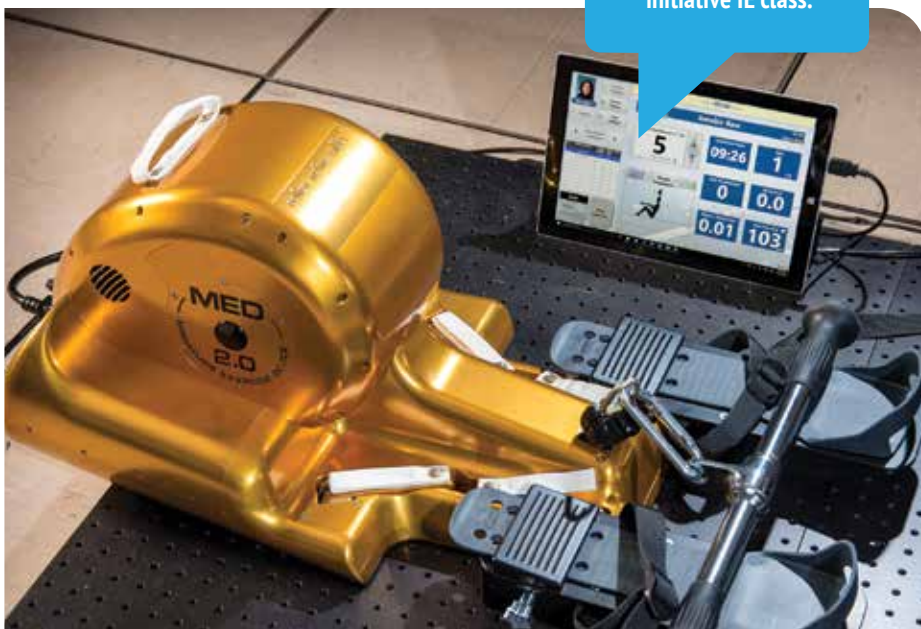
### THE MINIATURE EXERCISE DEVICE-2 (MED-2)

is a compact, all-in-one exercise device new to the International Space Station. A hallmark of efficiency and innovation, its journey from funding to flight in a year is just one of its amazing achievements.

The MED-2 boasts the ability to facilitate both aerobic and resistive workouts. The sleek 65-pound device will be attached to the existing Advanced Resistive Exercise Device (ARED) platform on station for testing. Using the existing ARED platform means the MED-2 team doesn't have to develop its own solution for absorbing vibrations.

The Med-2's Microsoft Surface-powered interface allows crew members to log into their profile, switch between different types of workouts and calibrate resistance. The software also collects and syncs exercise data with trainers on the ground. The MED-2 team worked with other groups at Johnson Space Center who use a Microsoft Surface for their projects to get the tablet ready for spaceflight.

Deep-space vehicles like Orion aren't as roomy as station, so everything—including exercise equipment—needs to be downsized. MED-2 is bringing us one step closer to being able to keep astronauts' bodies healthy on long journeys to the moon, Mars and beyond.



NASA/PHOTO

The MED-2 was developed under principal investigator Fernando Zumbado as part of the 5X2015 initiative 1E class. The 5X2015 initiative was created to streamline processes and identify gaps in the development of flight projects.

## NASA targets May 2018 launch of Mars InSight mission

### NASA'S INTERIOR EXPLORATION USING SEISMIC

**INVESTIGATIONS,** Geodesy and Heat Transport (InSight) mission to study the deep interior of Mars is targeting a new launch window that begins May 5, 2018, with a Mars landing scheduled for Nov. 26, 2018. InSight's primary goal is to help us understand how rocky planets—including Earth—formed and evolved. The spacecraft had been on track to launch this month until a vacuum leak in its prime science instrument prompted NASA in December to suspend preparations for launch.

InSight project managers recently briefed officials at NASA and France's space agency, Centre National d'Études Spatiales (CNES), on a path forward; the proposed plan to redesign the science instrument was accepted in support of a 2018 launch.

"The science goals of InSight are compelling, and the NASA and CNES plans to overcome the technical challenges are sound," said John Grunsfeld, associate administrator for NASA's Science Mission Directorate in Washington. "The quest to understand the interior of Mars has been a longstanding goal of planetary scientists for decades. We're excited to be back on the path for a launch, now in 2018."

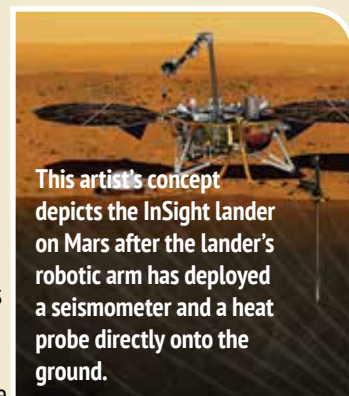
NASA is on an ambitious journey to Mars that includes sending humans to the Red Planet, and that work remains on track. Robotic spacecraft

are leading the way for NASA's Mars Exploration Program, with the upcoming Mars 2020 rover being designed and built, the Opportunity and Curiosity rovers exploring the Martian surface, the Odyssey and Mars Reconnaissance Orbiter spacecraft currently orbiting the planet, along with the Mars Atmosphere and Volatile Evolution Mission (MAVEN) orbiter, which is helping scientists understand what happened to the Martian atmosphere.

Johnson Space Center is home to the Astromaterials Research and Exploration Science Directorate, which conducts research leading to an understanding of the origin, evolution and composition of the solar system.

Learn more about ARES at: <http://ares.jsc.nasa.gov/>

For addition information about the mission, visit: <http://www.nasa.gov/insight>



This artist's concept depicts the InSight lander on Mars after the lander's robotic arm has deployed a seismometer and a heat probe directly onto the ground.

NASA/JPL-CALTECH



# Earth, sweet Earth

**NASA ASTRONAUT AND EXPEDITION 46 COMMANDER SCOTT KELLY AND HIS RUSSIAN COUNTERPART MIKHAIL KORNIENKO** returned to Earth March 1 after a historic 340-day mission aboard the International Space Station. Joining their return trip aboard a Soyuz TMA-18M spacecraft was Sergey Volkov, also of the Russian space agency Roscosmos, who arrived on the station Sept. 4, 2015.

“Scott Kelly’s one-year mission aboard the International Space Station has helped to advance deep space exploration and America’s Journey to Mars,” said NASA Administrator Charles Bolden. “Scott has become the first American astronaut to spend a year in space and, in so doing, helped us take one giant leap toward putting boots on Mars.”

During the record-setting one-year mission, the station crew conducted almost 400 investigations to advance NASA’s mission and benefit all of humanity. Kelly and Kornienko specifically participated in a number of studies to inform NASA’s Journey to Mars, including research into how the human body adjusts to weightlessness, isolation, radiation and the stress of long-duration spaceflight.



NASA/JOEL KOWSKY

▶ Expedition 46 Commander Scott Kelly of NASA is seen after returning to Ellington Field in Houston on March 3 after his return to Earth.

▶ (Inset) Matryoshka dolls depicting Kelly, left, and Russian cosmonauts Sergey Volkov and Mikhail Kornienko were given as gifts to the crew at the Zhezkazgan Airport in Kazakhstan on March 2.

Kelly’s identical twin brother, former NASA astronaut Mark Kelly, participated in parallel twin studies on Earth to help scientists compare the effects of space on the body and mind down to the cellular level.

One particular research project examined fluid shifts that occur when bodily fluids move into the upper body during weightlessness. These shifts may be associated with visual changes and a possible increase in intracranial pressure, which are significant challenges that must be understood before humans expand exploration beyond Earth’s orbit. The study uses the Russian Chibis device to draw fluids back into the legs while the subject’s eyes are measured to track any changes. NASA and Roscosmos already are continuing the investigation looking at Fluid Shifts with future space station

One-year mission concludes, breaking records while furthering science

The crew of the unique space station, that covers more than 90 percent of Earth’s population, to monitor and capture images of our planet. They also welcomed the arrival of a new instrument to study the signature of dark matter and conducted technology demonstrations that continue to drive innovation, including a test of network capabilities for operating swarms of spacecraft.

Kelly and Kornienko saw the arrival of six resupply spacecraft during their mission. Kelly was involved in the robotic capture of two NASA-contracted cargo flights – SpaceX’s Dragon during the company’s sixth commercial resupply mission and Orbital ATK’s Cygnus during the company’s fourth commercial resupply mission. A Japanese cargo craft and three Russian resupply ships also delivered several tons of supplies to the station.

Kelly ventured outside the confines of the space station for three spacewalks during his mission. The first included a variety of station upgrade and maintenance tasks, including routing cables to prepare for new docking ports for U.S. commercial crew spacecraft. On a second spacewalk, he assisted in the successful reconfiguration of an ammonia cooling system and restoration of the station to full solar power-generating capability. The third spacewalk was to restore functionality to the station’s Mobile Transporter system.

The space station is a convergence of science, technology and human innovation that enables us to demonstrate new technologies and make research breakthroughs not possible on Earth. It has been continuously occupied since November 2000 and, since then, has been visited by more than 200 people and a variety of international and commercial spacecraft. The space station remains the springboard to NASA’s next giant leap in exploration, including future missions to an asteroid and Mars.

For more information about the one-year mission, visit:

<http://www.nasa.gov/oneyear>



# The science behind Scott Kelly's #YearInSpace

Through research on astronaut Scott Kelly in seven major areas, we will improve our understanding of how the human body reacts to long-duration spaceflight. Testing began one year before his launch, intensified during his 340 days in space, and will continue for a year — or longer — after his return to Earth. The results of this research will help prepare us for future voyages beyond low-Earth orbit.

## Visual Impairment

Has Scott's vision been impaired? Fluid shifts in microgravity can put pressure on the optic nerves. These investigations examine ocular health and the body's response to fluid shifts in a microgravity environment.

## Human Factors

Will Scott's fine motor skills, which are important to controlling a spacecraft, diminish? These investigations also examine how astronauts interact with their environment aboard the International Space Station.

## Microbial

Will the collection of microbes in and on Scott's body change in space? Environmental factors like stress and diet can affect the microbiome, which can — in turn — affect overall health. These investigations examine changes in the microbiome of astronauts during spaceflight.

## Functional

Can Scott perform tasks such as opening a spacecraft hatch after landing or walking? These investigations examine the changes in an astronaut's performance of basic tasks and related psychological responses after 12 months in space.

## Behavioral Health

Has living in space affected Scott's psychological health? Stressful environments can impair cognitive performance. These investigations measure reaction time, reasoning and mood.

## Metabolic

With samples of blood, urine and saliva, we're getting a comprehensive look at Scott's overall health, including his immune system and nutritional status.

## Physical Performance

How strong are Scott's bones, muscles and cardiovascular system? These investigations examine exercise capability with a focus on physical performance.

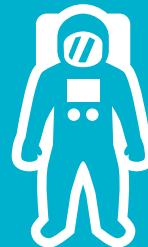
Learn more about every #YearInSpace investigation at:  
[www.nasa.gov/1ym/research](http://www.nasa.gov/1ym/research)





# One-year mission (by the numbers)

For decades, students have been scoffing at their math teachers, vowing that the calculation of numbers would never come in handy for them. But for the one-year crew's historic and record-breaking mission, numbers have a story to tell—and they will not be silenced. Not even to give credence to the moans of children around the world.



## Behold—Houston, we have some large numbers:

- With the end of this mission, NASA astronaut Scott Kelly now has spent 520 days in space, the most among U.S. astronauts
- Mikhail Kornienko has now accumulated 516 days across two flights
- Including crewmate Gennady Padalka, with whom Kelly and Kornienko lunched on March 27, 2015, 10 astronauts and cosmonauts representing six different nations (the United States, Russia, Japan, Denmark, Kazakhstan and England) lived aboard the space station during the yearlong mission
- Orbits of Earth for Kelly and Kornienko—5,440
- Miles traveled for Kelly and Kornienko—143,846,525 statute miles
- During the yearlong mission, almost 400 experiments were conducted aboard the orbiting laboratory
- Kelly conducted three spacewalks totaling 18 hours, 20 minutes; those were the first three of his career
- Kelly and Kornienko saw the arrival of nine visiting vehicles: three Russian Progress resupply ships; one Japanese H-II Transfer Vehicle; one SpaceX Dragon resupply ship; one Orbital/ATK Cygnus resupply ship; and three Soyuz crew vehicles





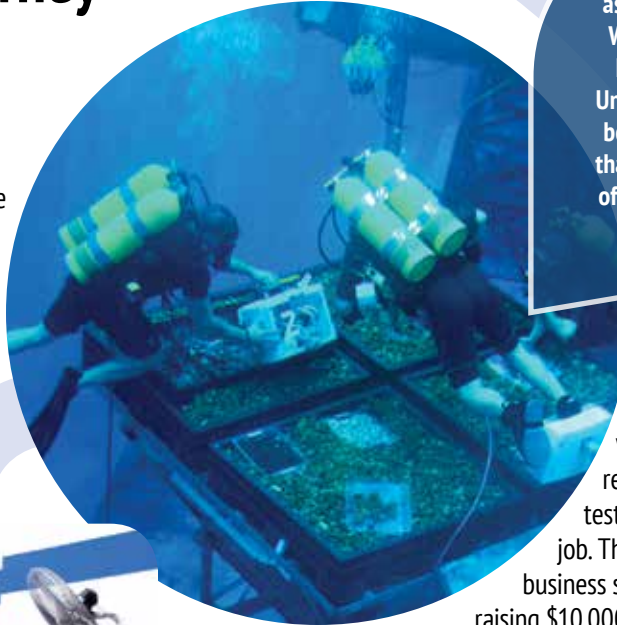
# Micro-g NExT encourages student to take next steps in NASA journey

BY HAYLEY FICK

## EVERY NASA JOURNEY IS ITS OWN STORY.

Embry Riddle Aeronautical University sophomore Cameron Wichman had no idea that his would involve transition from military to college to NASA in less than a year.

Last summer, Wichman participated in NASA's Micro-g Neutral Buoyancy Experiment Design Teams (Micro-g NExT) with a team of undergraduates from Embry Riddle. Little did he know at the time, he'd soon be helping support the activity that brought him to Johnson Space Center.



NBL divers test tools on the asteroid test bed designed by Wichman and the team from Embry Riddle Aeronautical University. Each bay of the test bed is comprised of materials that simulate the compositions of different types of asteroids.

NASA/JAMES BLAIR

types of asteroids and replicating them with simulated asteroid regolith in four different test bays was only half of the job. The team also explored the business side of the space industry, raising \$10,000 to fund their research through donations and grants.

Encouraged by a presentation about NASA internships he received as a Micro-g NExT participant, he felt inspired to take the next step. Wichman is now an intern in the JSC Office of Education, working to enhance the Micro-g NExT experience. He is using his familiarity with the program to optimize the student experience.

Dr. Alotta Taylor, program manager for NASA's Office of Human Exploration and Operations, said that Wichman's story holds true to the goals of the Micro-g NExT program, which aims to provide valuable opportunities for high-quality experiential learning.

"It allows learners to build on their knowledge and skills, and it increases their chances of networking with professionals that could help lead to employment at NASA, or even in industry," Taylor said.

Wichman is excited about encouraging other participants to take the next step on their NASA journey. Micro-g NExT kicks off its second year of test weeks this April, and students will get to hear from someone who has been in their shoes about the world of possibilities that can open up for them.



NASA/JAMES BLAIR

Cameron Wichman (here in light blue) and the team from Embry Riddle Aeronautical University watch as their simulated asteroid test bed is lowered into the water at NASA's Neutral Buoyancy Laboratory.

As participants in Micro-g NExT, Wichman and approximately 100 university students across the United States contributed design concept ideas for spacewalk tools based on five challenges directly tied to NASA's Asteroid Redirect Mission. Nineteen of those ideas were chosen to be tested underwater at NASA's Neutral Buoyancy Laboratory (NBL), a 40-foot-deep pool where astronauts train for spacewalks in a simulated microgravity environment.

"It was a surreal experience that allowed me to feel like a contributing member in the human spaceflight machine," Wichman said.

Wichman's team designed the simulated asteroid test bed, which other teams interacted with underwater during the virtual spacewalks. However, researching the compositions of different



NASA/JAMES BLAIR

Wichman and the Embry Riddle Aeronautical University team monitor video feeds at the NBL to see how their simulated asteroid test bed is performing underwater.





# Space Launch System's first flight to carry sci-tech satellites

**THE FIRST FLIGHT OF NASA'S NEW ROCKET—THE SPACE LAUNCH SYSTEM (SLS)**—will carry 13 CubeSats to test innovative ideas, along with an uncrewed Orion spacecraft, in 2018.

These small satellite secondary payloads will carry science and technology investigations to help pave the way for future human exploration in deep space, including the journey to Mars. SLS' first flight, Exploration Mission-1 (EM-1), provides the rare opportunity for these small experiments to reach deep space destinations. (Most launch opportunities for CubeSats are limited to low-Earth orbit.)

"The 13 CubeSats that will fly to deep space as secondary payloads aboard SLS on EM-1 showcase the intersection of science and technology and advance our journey to Mars," said NASA Deputy Administrator Dava Newman.

Secondary payloads were selected through a series of announcements of flight opportunities, a NASA challenge and negotiations with NASA's international partners.

NASA selected two payloads through the Next Space Technologies for Exploration Partnerships (NextSTEP) Broad Agency Announcement:

- **Skyfire** - Lockheed Martin Space Systems Company, Denver, Colorado, will develop a CubeSat to perform a lunar flyby of the moon, taking sensor data during the flyby to enhance our knowledge of the lunar surface
- **Lunar IceCube** - Morehead State University, Kentucky, will build a CubeSat to search for water ice and other resources at a low orbit of only 62 miles above the surface of the moon

Three payloads were selected by NASA's Human Exploration and Operations Mission Directorate:

- **Near-Earth Asteroid Scout, or NEA Scout**, will perform reconnaissance of an asteroid, take pictures and observe its position in space
- **BioSentinel** will use yeast to detect, measure and compare the impact of deep space radiation on living organisms over long durations in deep space
- **Lunar Flashlight** will look for ice deposits and identify locations where resources may be extracted from the lunar surface

Two payloads were selected by NASA's Science Mission Directorate:

- **CuSP**, a "space weather station," will measure particles and magnetic fields in space, testing practicality for a network of stations to monitor space weather
- **LunaH-Map** will map hydrogen within craters and other permanently shadowed regions throughout the moon's south pole

Three additional payloads will be determined through NASA's Cube Quest Challenge. CubeSat builders will vie for a launch opportunity on SLS' first flight through a competition that has four rounds, referred to as ground tournaments, leading to the selection in 2017 of the payloads to fly on the mission.

NASA has also reserved three slots for payloads from international partners.

On EM-1, SLS will launch the Orion spacecraft to a stable orbit beyond the moon to demonstrate the integrated system performance of Orion and the SLS rocket before the first crewed flight. The first configuration of SLS that will fly on EM-1 is referred to as Block I and will have a minimum 70-metric-ton (77-ton) lift capability and be powered by twin boosters and four RS-25 engines. The CubeSats will be deployed following Orion separation from the upper stage and once Orion is a safe distance away. Each payload will be ejected with a spring mechanism from dispensers on the Orion stage adapter. Following deployment, the transmitters on the CubeSats will turn on, and ground stations will listen for their beacons to determine the functionality of these small satellites.

**Hungry for more  
Journey to Mars? Visit:  
<http://www.nasa.gov/journeymars>**



# After a year in space ...

## snapshots



Astronaut Scott Kelly posted this picture of the moon taken from the International Space Station with the caption, "Day 97. Good night, Moon. Good night from @Space\_Station! #YearInSpace"



PHOTO: NASA



NASA/PHOTO

On June 14, 2015, the crew of Expedition 44 observes Flag Day in the United States in the cupola, the 360-degree observation point.



PHOTO: NASA

Night Earth observation of Japan taken by Expedition 44 crew member Kelly, with a Soyuz Spacecraft connected to the Mini Research Module 1 and a Progress spacecraft visible. Kelly posted this photo to Twitter on July 25 with the caption, "#Goodevening #Japan. Showing @Astro\_Kimiya how to take pictures of #Earth at night. #YearInSpace."

Kelly posted this picture to Twitter on July 13, 2015, with the caption, "#GoodMorning #Aurora! Good to see you again. #YearInSpace"



PHOTO: NASA



The Roundup is an official publication of the National Aeronautics and Space Administration, Johnson Space Center, Houston, Texas, and is published by the External Relations Office for all Space Center employees. The Roundup office is located at the Johnson Space Center, Building 2. The mail code is AD94. Visit our website at: [http://www.nasa.gov/centers/johnson/roundup/roundup\\_toc.html](http://www.nasa.gov/centers/johnson/roundup/roundup_toc.html)  
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## Imagination takes flight



**OK, SO MAYBE THE AVERAGE EARTHLING** doesn't yet have the ability to hop on a spacecraft and voyage to other planets—but our imaginations can. NASA's Jet Propulsion Laboratory has made it even easier to do with their free, downloadable and eminently artsy "Visions of the Future" posters.

Imagination is the window into the future, and NASA strives to be bold in advancing the edge of possibility so that someday, with

the help of new generations of innovators and explorers, these visions of the future can become a reality. As you look through these inspired travel destinations, remember that you can be an architect of the future.

Download your favorite poster—or the whole collection—here:  
<http://www.jpl.nasa.gov/visions-of-the-future/>